Towards an Integrated, Multi-method Remote Sensing Strategy for Archaeological Landscape Analysis: the Discovery of the Rosnaree Enclosure, Brú na Bóinne, County Meath, Ireland

Kevin Barton

Landscape & Geophysical Services,

Convent Road, Claremorris, County Mayo, IRELAND.

kevin.barton@lgs.ie

www.lgs.ie

Conor Brady

Department of Humanities, Dundalk Institute of Technology,

Dublin Road, Dundalk, County Louth, IRELAND.

conor.brady@dkit.ie

http://rossnareedig.wordpress.com/

Historically for site discovery and delimitation aerial photography, and latterly LiDAR, has been used in the Brú na Bóinne World Heritage Site (WHS), an internationally significant archaeological landscape known for its many Neolithic passage tombs and other monuments (Fig 1). The question of Neolithic settlement distribution in Brú na Bóinne has largely been unexplored until the present Lithic Scatters Project which is using geophysical survey to follow-up mapped areas of lithic concentration. A component of the project is the assessment of remote sensing techniques in addressing key questions raised in the Brú na Bóinne WHS Research Framework.

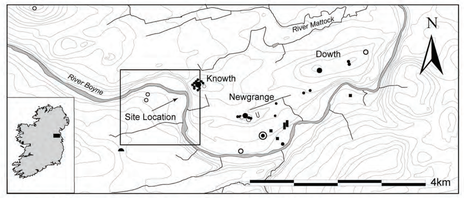


Fig 1 Location of Rosnaree within Brú na Bóinne WHS

The Brú na Bóinne landscape today is mainly composed of the floodplain and terraces of the River Boyne which are farmed in a combination of pasture crops and tillage. In the case of Rosnaree (Fig 1), the site was first identified through fieldwalking in 1999 as a large, dense scatter of worked lithics (chipped stone artefacts, primarily flint) in the NE corner of a tillage field.

There is no evidence for the site in a recent LiDAR survey (Fig 2) and from vertical and oblique aerial photography (Figs 3 & 4)

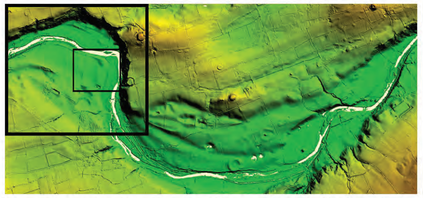


Fig 2 LiDAR image showing Rosnaree and the core area of Brú na Bóinne WHS

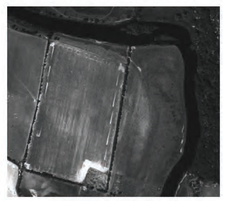


Fig 3 Rosnaree—vertical aerial photograph (Ordnance Survey of Ireland)

Fig 4 Rosnaree—oblique photograph taken from the east (Photo : Conor Brady)

Fig 5 Fieldwalking for lithic artefacts in the vicinity of Newgrange Passage Tomb, Brú na Bóinne (Photo: Conor Brady)

Fig 6 Button scrapers recovered by field-walking in Brú na Bóinne (Photo: Conor Brady)

The lithics (Figs 5 & 6) suggested intensive activity, possibly involving residential settlement, broadly dating to the Neolithic (4,000-2,500 cal BC).

Follow-up to the discovery of the lithics scatter (Fig 7A) used a combined topographic and reconnaissance topsoil magnetic susceptibility survey on a 10m x 10m grid (Fig 7B & 7C) which delineated a zone of susceptibility enhancement coincident with the dense scatter of lithics. The anomalous zone also appeared to be related to a small topographic rise in the NE corner of the field (Fig 7B).

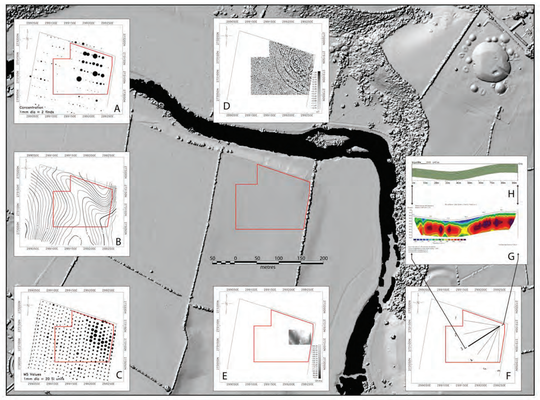


Fig 7: Montage of lithics, topography and geophysical survey results - A: Proportional symbol plot of lithics density recorded during initial fieldwalking survey. B: Microtopography (Contours at 0.2m intervals). C: Proportional symbol plot of reconnaissance magnetic susceptibility data. D: Magnetic gradiometry image. E: Earth resistance image. F: Location of transect ERT 3 used for radial electrical resistivity tomography and ground penetrating radar profiles. G: ERT 3 - Modelled electrical resistivity tomography pseudosection. H: Ground penetrating radar section.

The background for this image is from a recent LiDAR survey of the Brú na Bóinne World Heritage Site (courtesy of Meath County Council).

In 2008 a magnetic gradiometry survey (Fig 7D) funded by the Heritage Council revealed the presence of an enclosure which has a complex set of internal features and is likely to be multi-phase. The enclosure is multi-vallate and measures *c.*110m N-S x *c.*160m E-W. At the time of geophysical discovery a small area of the presumed core of the enclosure was surveyed using earth resistance (Fig 7E). The resistance response differed from the gradiometry response in revealing that one of the ditches lay in a broad zone of low resistance coincident with a channel-like feature seen in the topographic data.

In order to resolve some of the questions arising from the geophysical survey data a series of radial electrical resistivity tomography (ERT) and ground penetrating radar (GPR) transects were planned in 2009 (Fig 6F). ERT 3 (Fig 6G), confirmed the two outer ditches and showed the third ditch to lie in a presumed natural sediment-filled channel. The GPR survey (Fig 6H) results were disappointing with a subdued response and little correlation with the ERT results. This may be due to a combination of choice of GPR centre frequency and there being a significant silt and clay component in the topsoil and sub-soil resulting in the GPR signal being degraded.

Fig 8 Excavation area viewed from the east (Photo: Igor Murin)

In late 2009 it was decided to conduct a test excavation to provide secure dating for the features identified during the geophysical investigations, to explore some of their detail and to test some of the geophysical results. The most suitable location lay immediately to the north of the core area, where the gradiometry survey had been conducted (Fig 7D), on steeply sloping ground directly overlooking the bank of the River Boyne (Fig 8).
An earth resistance survey (Fig 9) was done in the area to be excavated as the steep and uneven terrain had prevented magnetic gradiometry being carried out. The survey imaged the interpreted ditches.

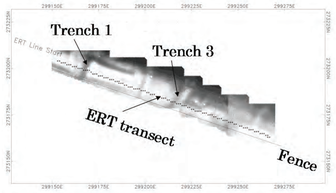


Fig 9 Earth resistance survey of the excavation area and location of ERT 7

In early 2010, in order to further assist the planning of the excavation, a 122m ERT transect (Fig 9) was carried out to optimise the location of the trenches relative to the ditches. ERT 7 (Fig 10) ran WSW – ESE sub-parallel with the slope and confirmed the location of the ditches seen in the gradiometry and resistance data. In addition the depth and extent of ditches to be excavated were interpreted from the modelled section allowing for appropriate allocation of excavation resources.

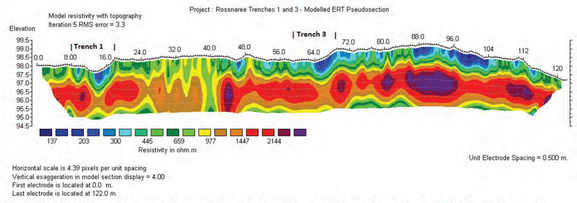


Fig 10 ERT 7 pseudosection with the location of Trenches 1 and 3 (v. exag. x 4)

The excavation of Trenches 1 (Fig 11) and 3 in July 2010 largely confirmed the geophysical interpretation and recovered artefacts which, pending C14 dating, are believed to be early medieval in date. These excavation results seem to indicate that the ditches are not Neolithic in date and the question of the nature of activity and possible location of the population in Neolithic times at Rosnaree remains unclear.

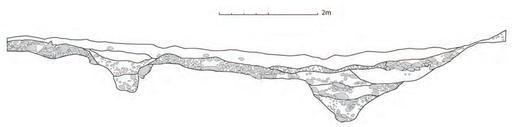


Fig 11 Section drawing from Trench 1 excavated across the outer ditch (v.exag. x 1)

In August 2010 further geophysical surveys with a higher spatial resolution were targeted on the core area of the enclosure. Magnetic susceptibility data (Fig 12) show a systematic zonation of enhancement over the core area. Magnetic gradiometry data (Fig 13) further define the enhancement and reveal features including a ditched enclosure some 30m x 26m in size (E1). Earth resistance data (Fig 14) confirm the ditch and in the southwest show it to lie in the presumed sediment-filled natural channel. This enclosure and nearby features will be possible excavation targets in 2011.

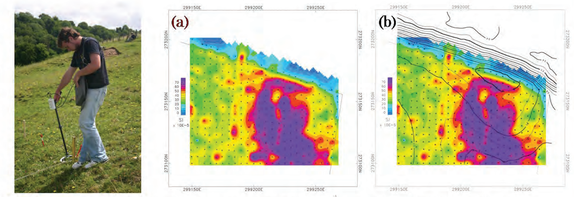


Fig 12 (a) Magnetic susceptibility (b) with topography (Photo: Conor Brady)

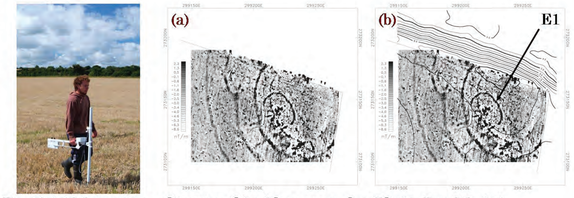


Fig 13 (a) Magnetic gradiometry (b) with topography (Photo: Igor Murin)

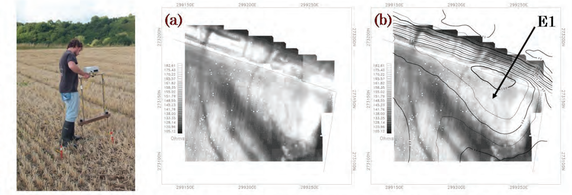
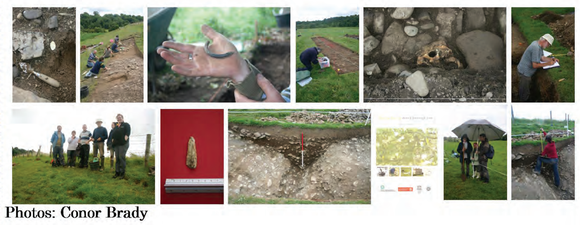


Fig 14 (a) Earth resistance survey (b) with topography (Photo: Igor Murin)

Investigation of this site addresses some of the key research questions identified in the Brú na Bóinne WHS Research Framework; developing new and refined methodologies in searching for new sites - in particular those related to settlement, the scale of operation of the monument complex, the changing environment and the significance of the River Boyne itself.
What can we learn from lithic scatter, remote sensing and excavation data from this site that can assist us in a larger scale geophysical evaluation of the archaeological potential of Brú na Bóinne WHS?

1. A systematic methodology is needed to address the key research questions relating to Brú na Bóinne
2. The starting point is a review of satellite imagery, LiDAR and aerial photography where available
3. In parallel with 2, fieldwalking to map possible lithic scatters
4. Following a synthesis of 2 & 3, reconnaissance magnetic susceptibility may further define and/or confirm follow-up targets
5. Magnetic gradiometry, earth resistance, electrical resistivity tomography and ground penetrating radar should be considered for inclusion in reconnaissance and follow-up survey programmes.



Photos: Conor Brady

Acknowledgements

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